REMARKS

The piezoelectric ceramic compositions of the present invention have an improved flexural strength that is achieved without degrading heat resisting properties. In illustrative examples, it is now possible to obtain heat resisting properties such that the absolute value $|\Delta F_0|$ of the rate of change in oscillation frequency F_0 before and after application of a thermal shock is 0.10% or less. And at the same time, the three-point flexural strength σ_{b3} is 160 N/mm^2 or greater.

The matters raised in the Office action are discussed below in the same order as presented by the Examiner. Initially, the claim amendments are summarized as follows.

- Claim 1 is amended to include the subject matter of prior claims 3 and 6.
- Claims 2, 3 and 6 are cancelled.
- Claim 8 is amended to delete Al from the additive group.
- Claims 11 and 12 are each amended in accordance with the amendment of claim 8 to refer to at least one additive selected from Ga, In, Ta and Sc, and also Al.
- Claim 15 is amended to delete Al from the additive group.
- Claim 16 is amended to include Al_2O_3.

•Claim 18 is supported by the lower limit of Al_2O_3 disclosed at page 8 of the specification.

•Claims 19 and 20 are supported by the lower and upper limits of Al_2O_3 disclosed at pages 8 and 9 of the specification and the upper limit of Al_2O_3 of claim 19 is also supported by original claim 11. The upper limit of Al_2O_3 of claim 20 is also supported by original claim 12.

It is requested that the Examiner reconsider and withdraw the rejection of claims 1-8, 11-12 and 14-16 under 35 USC 103(a)as being unpatentable over Ise in his publication "High Power Characteristics of Piezoelectric Ceramics in $Pb(Mn_{1/3}Nb_{2/3})O_3$-$PbTiO_3$-$PbZrO_3$ System" ("Ise") in view of Tajima in his publication "Electric-Field Induced Crack Growth Behavior in PZT/ Al_2O_3 Composites" ("Tajima"). The references provide no suggestion for their combination and no motivation for a predictable advantage to result from their combination is cited in the action as required by the decision in *KSR International Co. v. Teleflex Inc.*, 550 U.S. 398 (2007) and cited in Section 2143.01, III, of the MPEP.

Ise is concerned with an increased limit vibration velocity v_{max} in order to suppress heat generation. To that end, Ise teaches that his $Pb(Mn_{1/3}Nb_{2/3})O_3$-$PbTiO_3$-$PbZrO_3$ system

is superior to the prior art $Pb(Mn_{1/3}Sb_{2/3})O_3$-$PbTiO_3$-$PbZrO_3$ system. That is, the Ise improvement is based on the replacement of Sb with Nb in an otherwise identical composition. Ise does not mention the use of an Al containing phase as acknowledged by the Examiner.

In order to remedy this deficiency in Ise, Tajima is cited in connection with its teaching of the addition of Al_2O_3 to a $Pb(Zr_x,Ti_{1-x})O_3$ composition in order to inhibit crack growth. This combination of teachings is not supported by a similarity of the problems addressed by Ise and Tajima, and there is no predictability of the results to be achieved by the combination as required by *KSR* and particularly cited in Section 2143.01, III, of the MPEP:

> The mere fact that references can be combined or modified does not render the resultant combination obvious unless **> the results would have been predictable to one of ordinary skill in the art. *KSR International Co. v. Teleflex Inc.*, 550 U.S. ___, ___, 82 USPQ2d 1385, 1396 (2007).

In the present case, the Examiner argues that the advantages of Al_2O_3 will be achieved in Ise. As detailed below, this combination of teachings is not obvious since there is no reasonable expectation or predictability of success for the

combination. This is true herein because the piezoelectric compositions are substantially different.

There is no basis to assume the transfer or achievement of the Tajima advantages to the distinct Ise composition. This is demonstrated by the fact that the improvement in Ise is based on a much smaller variation in composition than exists between the Ise and Tajima compositions. That is, the Ise improvement resulted from the replacement of Sb with Nb in $Pb(Mn_{1/3}Nb_{2/3})O_3$-$PbTiO_3$-$PbZrO_3$. In contrast, the Examiner argues without reasonable expectation of success, and certainly without predictability of result, that the Tajima addition of Al_2O_3 to $Pb(Zr_x,Ti_{1-x})O_3$ will provide like benefits in the $Pb(Mn_{1/3}Nb_{2/3})O_3$-$PbTiO_3$-$PbZrO_3$ system of Ise. Moreover, there is no basis to believe that any possible improvement in the inhibition of crack growth would be achieved without detriment to the increased limit vibration velocity v_{max} upon which the invention is based in Ise. For these reasons, the proposed combination of references and modification to reach the present invention is not obvious as required by the holding in *KSR* as particularly cited in Section 2143.01, III, of the MPEP.

The lack of predictability of improvements evidenced by the above noted differences between the compositions in Ise and Tajima is supplemented by the prior art discussed in the

present application at pages 2 and 3 of the specification. As there noted, Japanese Patent publication No. 2000-103674 teaches the addition of Mn to improve heat resisting properties. Japanese Patent publication No. 2003-128462 teaches that SiO_2 teaches improved flexural strength, but causes degradation of the heat resisting properties. Thus, there is no expectation or likelihood that the addition of Al_2O_3 will not yield a like degradation of the limit vibration velocity v_{max} in Ise and the heat resisting properties in the present invention. Accordingly, there is not an obvious transfer or combination of properties via additives even in like systems.

It is therefore submitted that the proposed combination of the teachings in Ise and Tajima is not proper. The motivation and predictability requirements of *KSR,* as acknowledged in Section 2143.01, III, of the MPEP, are not met.

For at least the reasons set forth above, the rejection of the claims 1-8, 11-12 and 14-16 based on the foregoing combination of prior art teachings is in error and should be withdrawn.

It is further noted that amended claims 8 and 15 do not recite an Al additive. The recited additive group of at least one of Ga, In, Ta and Sc is not met by the Ise and

Tajima teachings. For these further reasons, the rejection of claims 8 and 15 should be withdrawn.

It is submitted that the foregoing amendments of claims 8 and 15 overcome the rejection of claims 9, 10 and 17 under 35 USC 103(a) as being unpatentable over Ise in view of Tajima as applied above, and further in view of the Hammer publication "Correlation Between Surface Texture and Chemical Composition of Undoped, Hard and Soft Piezoelectric PZT Ceramics" ("Hammer"). Hammer fails to disclose a composition comprising at least one of Ga, In, Ta and Sc.

For the same reasons as set forth above, it is submitted that the rejection of claim 13 under 35 USC 103(a) as being unpatentable over Ise in view of Tajima, and further in view of US patent 6299791 to Yoshizawa ("Yoshizawa") is in error and should be withdrawn. Yoshizawa is specifically cited for its teachings in connection with the addition of SiO_2, and therefore, does not remedy the deficiencies of the Ise and Tajima.

In addition to the foregoing reasons, it is noted that the Yoshizawa reference was cited against the corresponding applications in Taiwan and China and overcome by the claim amendments presented herein. Among the piezoelectric ceramic samples disclosed in Yoshizawa, Sample No. 42 has the largest amount of Al_2O_3, and that amount is 0.120 wt%.

Accordingly, claim 1 in the Taiwanese and the Chinese patent applications were amended to recite an Al_2O_3 content in the amount of 0.15 to 15.0 wt%. Although Yoshizawa was cited against only claim 13 in this application, it is noted that the range of Al_2O_3 in claim 1 has been similarly limited and is similarly distinguished.

It is further submitted that Yoshizawa actually teaches away from the present invention. More particularly, Yoshizawa proposes to add 0.003 to 0.1 wt% Al_2O_3 to the main component, and Sample No. 42 is merely a comparative example. Yoshizawa specifically teaches away from the Al_2O_3 ranges of the present invention in column 3, third paragraph, where an Al_2O_3 range exceeding 0.1 wt% is rejected. In contrast, it is not believed that the relatively small amount of Al_2O_3 taught by Yoshizawa will generate the Al-containing phase as set forth in claim 1 of the present invention. This is discussed in greater detail at page 8 of the specification.

It is also submitted that new claims 18, 19 and 20 are further distinguished over Ise and Tajima by the claimed Al_2O_3 amounts. Tajima teaches an Al_2O_3 amount of 0.5 to 1 vol% which corresponds with 0.25 to 0.5 wt% assuming the density of PZT and Al_2O_3 to be 8 g/cm^3 and 4 g/cm^3. Each of claims 18, 19 and 20 recites an Al_2O_3 lower limit of 0.6 wt%.

For all of the foregoing reasons, claims 1, 4, 5 and 7 - 20 are in condition for allowance and such action is requested.

If there are any fees required by this Amendment, please charge the same to Deposit Account No. 16-0820, Order No. OBA-40858.

Respectfully requested,

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